CERTIFICATION

I, Katsumi TAGUCHI, whose address is Tokushima Bldg., 7th Floor, 9-10, Minamisemba 3-chome, Chuo-ku, Osaka JAPAN, hereby certify that I am the translator of the attached document, namely Japanese Patent Application No.2002-330057 filed on November 13, 2002, that I am familiar with both the Japanese language and the English language, and that the translation is a true and correct translation from the Japanese language to the English language to the best of my knowledge and belief.

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[Title of the invention] Electric Toothbrush

[Claims]

[Claim 1] An electric toothbrush comprising:

a motor having a driving shaft;

a lever shaft which is provided substantially in range with the driving shaft and is pivoted so as to swing about a predetermined point to support rotationally end portions;

a brush body pivoted so as to freely rotate about a rotating shaft which is located in an opposite side of the driving shaft to be substantially perpendicular to the lever shaft;

a first motion converting mechanism which converts rotating motion of the driving shaft into swinging motion of the end portion of the lever shaft; and

a second motion converting mechanism which converts swinging motion of the end portion 5b of the lever shaft into reciprocal rotating motion of the brush body.

[Claim 2] The electric toothbrush as stated in claim 1, wherein

the first motion converting mechanism is comprised of an eccentric member which is coupled to the driving shaft and rotates about the driving shaft corresponding to rotating motion of the driving shaft, and a joint portion which is provided at the first end portion of the lever shaft, comes into contact with an outer peripheral face of the eccentric shaft of the eccentric member, and converts rotating motion of the eccentric shaft into swinging motion of the lever shaft, and the swinging shaft may form an optional angle including right angle with respect to the driving shaft of the motor.

[Claim 3] The electric toothbrush as stated in claim 2, wherein a roller is provided in a portion where the eccentric shaft and the joint portion have contact with each other.

[Claim 4] The electric toothbrush as stated in claim 1, wherein the first motion converting mechanism is a slider-crank mechanism for converting

rotating motion of the driving shaft of the motor into reciprocal linear motion of the first end portion of the lever shaft.

[Claim 5] The electric toothbrush as stated in one of claims 1 to 4, wherein the second motion converting mechanism is comprised of a pin provided at one of the second end portion of the lever shaft or the brush body and a groove which is provided at the other of the second end portion of the lever shaft or the brush body and with which the pin is slidably engaged, and an axis of the pin may form an optional angle including right angle with respect to the longitudinal direction of the groove.

[Claim 6] The electric toothbrush as stated in one of claims 1 to 5, wherein a swinging plane of the second end portion of the lever shaft forms a predetermined angle with respect to the driving shaft of the motor.

[Claim 7] The electric toothbrush as stated in one of claims 1 to 6, wherein the rotating shaft of the brush body forms a predetermined angle except substantially right angle with respect to the swinging plane of the second end portion of the lever shaft.

[Claim 8] The electric toothbrush as stated in one of claims 1 to 7, wherein plural lever shafts are provided in connection with each other in an axial direction to transmit the swinging motion, the lever shaft in the first end portion is connected with the motor shaft via the first motion converting mechanism, and the lever shaft in the other end portion is connected with the brush body via the second motion converting mechanism.

[Claim 9] The electric toothbrush as stated in one of claims 1 to 8, wherein bending rigidity of the lever shaft is set so that swinging range of the second end portion of the lever shaft becomes smaller as a load transmitted from the brush body to the lever shaft through the second motion converting mechanism is increased.

[Claim 10] The electric toothbrush as stated in one of claims 1 to 9, wherein the rotating shaft of the brush body is supported by a holding member held so as to freely rotate in the three-dimensional direction.

[Claim 11] The electric toothbrush as stated in one of claims 1 to 10,

wherein a body of electric toothbrush is formed of a grip portion provided with the motor and the brush body which has the lever shaft and the brush body and is detachable from the grip portion.

[Detailed description of the invention]

[0001]

[Field of the invention]

The present invention relates to an electric toothbrush, in particular, a mechanism for converting rotating motion of a motor into reciprocal rotating motion of a brush body.

[0002]

[Prior art]

An electric toothbrush for performing brushing by putting a brush implanted in a brush body on teeth while reciprocally rotating the disk-like brush body about an axis orthogonal to the longitudinal direction of a grip portion of the electric toothbrush has been known conventionally. As such an electric toothbrush which converts rotating motion of a motor shaft into reciprocal rotating motion of the brush body, a system described below is used, for example.

[0003]

There is a system that a shaft is rotationally driven by a rotating motion of a motor shaft and the rotation of the shaft is converted into reciprocal rotating motion in a brush body by using a crank structure (refer to Patent Document 1) as a first system. However, in this system, since the crank structure should be provided in the brush body, so that the brush body itself cannot be thinly formed. In addition, the structure cannot be simplified by reason that a bearing of the shaft should be accurately provided, so that when accuracy of the bearing is poor, transmission efficiency of driving force is lowered or it causes the occurrence of noise, and it is practically impossible to incline the head portion at an optional angle by reason that the shaft is limited to a linear shape.

[0004]

There is the other system that rotating motion of a motor shaft is

converted into reciprocal rotating motion of a shaft by using a gear and a cam, and the reciprocal rotating motion is converted into reciprocal rotating motion through a miter gear mechanism in a brush body (refer to Patent Document 2). There is still another system that rotating motion of a motor shaft is converted into linear reciprocal motion in axial direction of a shaft by using a gear and a cam and a brush body is reciprocally rotated by the linear reciprocal motion (refer to Patent Document 3). However, the above systems also have the problem similar to the first system.

[0005]

[Patent Document 1]

National Publication of International Patent Application No. 11-505742

[Patent Document 2]

Japanese Laid-Open Patent Publication No. 5-137615

[Patent Document 3]

Japanese Laid-Open Patent Publication No. 6-121710

[0006]

[Problems to be solved by the invention]

To solve the above-mentioned conventional problems, an object of the present invention is to provide an electric toothbrush with higher transmittance efficiency of the driving force, which is capable of inclining a rotating shaft of a brush body and a head portion at an optional angle with respect to a grip portion and making the head portion put into a user's mouth smaller or thinner in order to improve operability during brushing.

[0007]

[Means for solving the problems]

To achieve the above-mentioned object, an electric toothbrush in accordance with an aspect of the present invention comprises a motor 3 having a driving shaft 3a, a lever shaft 5 which is provided substantially in range with the driving shaft 3a and is pivoted so as to swing about a predetermined point 9 to support rotationally end portions 5a and 5b, a brush body 4 pivoted so as to freely rotate about a rotating shaft which is

located in an opposite side of the driving shaft 3a to be substantially perpendicular to the lever shaft 5, a first motion converting mechanism 51 which converts rotating motion of the driving shaft 3a into swinging motion of the first end portion 5a of the lever shaft 5, and a second motion converting mechanism 52 which converts swinging motion of the second end portion 5b of the lever shaft 5 into reciprocal rotating motion of the brush body 4. With such a configuration, in the lever shaft 5, high accuracy in processing of parts is not required except for the point 9 and decrease of transmission efficiency of force or noise can be efficiently avoided, and thus the simply and inexpensive electric toothbrush can be provided. Moreover, even when the lever shaft 5 is not linearly formed, the force can be properly transmitted by supporting the lever shaft 5 by the point 9, so that it becomes possible to incline the proximity of the brush body 4 at an optional angle.

[0008]

Moreover, it is also preferable that the first motion converting mechanism 51 is comprised of an eccentric member 6 which is coupled to the driving shaft 3a and rotates about the driving shaft 3a corresponding to rotating motion of the driving shaft 3a, and a joint portion 7 which is provided at the first end portion 5a of the lever shaft 5 and converts rotating motion of the eccentric shaft 6 into swinging motion of the lever shaft 5, and with such a configuration, the power transmission can be realized with high efficiency by the simply structure.

[0009]

Moreover, it is also preferable that a roller 25 is provided in a portion where the eccentric shaft 6 and the joint portion 7 have contact with each other, and according to this configuration, an occurrence of abrasion resistance is avoided and the life of the first motion converting mechanism 51 can be thereby extended.

[0010]

Moreover, it is also preferable that the first motion converting mechanism 51 is a slider-crank mechanism 54 for converting rotating

motion of the driving shaft 3a into reciprocal linear motion of the first end portion 5a of the lever shaft 5, and according to this configuration, the power transmission can be realized with high efficiency by the simply structure.

[0011]

Moreover, it is also preferable that the pin 14 is provided in either the second end portion 5b of the lever shaft 5 or the brush body 4, and the groove 13 is provided in the other and pivoted so as to swing about the pin 14 and convert swing motion of the second end portion 5b of the lever shaft 5 into reciprocal rotating motion of the brush body 4 as the second motion converting mechanism 52. According to this configuration, the power transmission can be realized with high efficiency by the simply structure, and the brush body 4 can be thinly formed, so that usability in a user's mouth can be improved. Moreover, there occurs no problem to transmit the power even when the brush body 4 is inclined with respect to the lever shaft 5, so that it is possible to incline the proximity of the brush body 4 at an optional angle.

[0012]

Moreover, it is also preferable that the lever shaft 5 is inclined at any angle, and according to this configuration, it is possible to put the end of the brush to every corner of teeth, thereby improve operability during brushing and remove plaque efficiently.

[0013]

Moreover, it is also preferable that the angle between the driving shaft 3a in the first motion converting mechanism 51 and the lever shaft 5 and the angle between the lever shaft 5 and the brush body 4 are optionally set, and according to this configuration, it is possible to put the end of the brush to every corner of teeth, thereby improve operability during brushing and remove plaque efficiently.

[0014]

Moreover, it is also preferable that the plurality of the lever shafts 35a, 35b, ...are provided to connect with each other in the axial direction

so that the swing motion is transmitted, and one end portion of the plurality of the lever shafts 35a, 35b, ...is connected with the driving shaft 3a through the first motion converting mechanism 51 and the other end portion of the plurality of the lever shafts 35a, 35b, ...is connected with the brush body 4 through the second motion converting mechanism 52. According to this configuration, it is possible to incline the proximity of the brush body 4 at an optional angle by connecting the adjacent lever shafts 35a, 35b, ...at an angle, so that it is possible to put the end of the brush to every corner of teeth, thereby improve operability during brushing and remove plaque efficiently.

[0015]

Moreover, it is also preferable that the bending rigidity of the lever shaft 5 set to make the moving distance of the lever shaft at the brush body 4 side is decreased as pressure transmitted from the brush body 4 to the lever shaft 5 through the second motion converting mechanism 52. According to this configuration, the rotation angle of the brush body 4 is decreased when the brush is highly pressed, and damage to the gums and enamelum of the tooth surface can be prevented while brushing.

[0016]

Moreover, it is also preferable that the brush body 4 which rotates about the rotating shaft 10 can freely change orientation in the three-dimensional direction, integrally with the holding member 18 holding the rotating shaft 10, and according to this configuration, the brush body 4 is rotated freely depending on the angle at which the brush 8 comes into contact with teeth during use and the tooth surface matches with the brush surface, and smooth and efficient brushing can be achieved.

[0017]

Moreover, it is also preferable that the electric toothbrush 1 is made up of the grip portion 40 having the motor 3 and the head portion 41 attachable to the grip portion 40 and having the lever shaft 5 and the brush body 4, and according to this configuration, the brush body 4 becomes detachable and the configuration of the grip portion 40 side can made to be

simple.

[0018]

[Embodiments of the invention]

The present invention is described on the basis of the preferred embodiment shown in the attached drawings. As shown in FIG. 1, an electric toothbrush 1 in accordance with the first embodiment comprises a motor 3 as a driving source, and a driving force transmitting mechanism for transmitting driving force to a brush body 4 in a housing 2. The brush body 4 is formed like a disk and detachably attached to a main body of the electric toothbrush 1. A rotating shaft 10 is provided in a bottom end portion of the brush body 4 in the housing 2, and the brush body 4 and the brush 8 can rotate integrally around the rotating shaft 10. The rotating shaft 10 is substantially perpendicular to a lever shaft 5 described below. Moreover, in the housing 2, the lever 5 is provided to make first and second end portions 5a and 5b swing like seesaw around the point 9 between the motor 3 and the brush body 4.

[0019]

A driving shaft 3a projected from the motor 3 toward the lever shaft 5 so that the driving shaft 3a and the lever shaft 5 are in the same straight line. As shown in FIGS. 2, 3, and so on, an eccentric member 6 is press-fitted to the driving shaft 3a. A joint portion 7 which is formed at a first end portion 5a of the lever shaft 5 positioned at the side of the motor 3 and engaged with an eccentric shaft 6a of the eccentric member 6. The eccentric shaft 6a of the eccentric member 6 is eccentric from the driving shaft 3a to rotate eccentrically according to the rotation of the driving shaft 3a, and the joint portion 7 transmits only reciprocal linear motion of the predetermined direction in rotation movement of the eccentric shaft 6a of the eccentric shaft 6 so that the first end portion 5a swing plane around the point 9. That is to say, in the present embodiment, the first motion converting mechanism 51 is comprised of an eccentric member 6 and a joint portion 7 which convert the rotating movement of the driving shaft 3a to the swinging movement of the first end portion 5a which is one of both

end portions of the lever shaft 5.

[0020]

A roller 11 may be provided as a roller member 25 in a position where the eccentric member 6 and the joint portion 7 have contact with each other as shown FIG. 4. In this case, a head portion 6a is formed by press-fitting the roller 11 rotatably to a shaft 12 and press-fitting one end of the shaft 12 to a base portion 6b of the eccentric member 6 to integrate the head portion 6a and the base portion 6b. A flange is formed at the opposite side to the side where the shaft 12 is press-fitted and can rotate, so that, although sliding friction occurs between the roller 11 and the shaft 12, friction between the roller 11 and the protrusion 7a of the joint portion 7 of the lever shaft 5 is decreased greatly. Since sliding friction between the roller 11 and the shaft 12 is generated in line contact, wear becomes relatively small. In contrast, when the roller 11 is not provided, sliding friction occurs in the position where the eccentric member 6 and the joint portion 7 have contact with each other, and abrasion occurs rapidly. That is to say, the above roller member 25 makes the first motion converting mechanism 51 have a longer life.

[0021]

The end portion 5b which is located opposite from the end portion 5a of the lever shaft 5 and the brush body 4 are shown in FIG. 5. As shown in FIG. 5, a groove 13 is provided in the second end portion 5b of the lever shaft 5 so that its end holds a cylindrical pin 14 which is parallel with and eccentric from the rotating shaft 10 in the bottom end portion of the brush body 4. The groove 13 penetrates in an axial direction of the pin 14, so that as shown in FIG. 6, when inserting the groove 13 into the pin 14 while facing the second end portion 5b of the lever shaft 5 with the brush body 4, the end portion of the second end portion 5b holds the pin 14 and the groove 13 and the pin 14 are rotatably connected with each other. The pin 14 can slide in an axial direction of the lever shaft 5 in the groove 13, and when the lever shaft 5 swing about the point 9, the whole brush body 4 performs reciprocal rotating motion around the rotating shaft 10.

[0022]

As described above, in the present preferred embodiment, the second motion converting mechanism 52 which converts the swing motion of the second end portion 5b of the lever shaft 5 into reciprocal rotating motion of the brush body 4 by providing the pin 14 in the brush body 4 and providing the groove 13 which is pivoted so as to swing about the pin 14 in the second end portion 5b of the lever shaft 5 so that the swing motion of the second end portion 5b of the lever shaft 5 is converted into the reciprocal linear motion of the brush body 4. However, the present invention is not limited to the above example, and as shown in FIG. 7, for example, a pin 14' is formed at the second end portion 5b of the lever shaft 5 as the second motion converting mechanism 52 and a groove 13' to which the pin 14' is engaged is formed at the brush body 4. The similar effects to the above-mentioned ones can be achieved by such configuration.

[0023]

The present invention has the configuration to transmit the power from the motor 3 to the brush body 4 by using the first motion converting mechanism 51, the lever shaft 5, the second motion converting mechanism 52, and so on, so that the power transmission can be realized with high efficiency by the simply structure, and the brush body 4 can be thinly formed. In addition, and only when the point 9 is accurately provided in the lever shaft 5, decrease of transmission efficiency of force or noise can be efficiently avoided, and thus the simply and inexpensive electric toothbrush can be provided.

[0024]

The present embodiment has an advantage to enable an efficient brushing by making the proximity of the brush 8 have an optional angle. In particular, as shown in FIG. 8, for example, an inflected portion 15 is provided in the lever shaft 5, and the lever shaft 5 may be inflected in an optional direction through the inflected portion 15. The inflected portion 15 may be provided between the first end portion 5a and the point 9 on the first motion converting mechanism 51 or between the point 9 and the

second motion converting mechanism 52. In either case, only when supporting the lever shaft 5 swingably and firmly, the similar power transmission can be achieved through the first motion converting mechanism 51 and the second motion converting mechanism 52. Moreover, according to this configuration, the central axis C_2 of the head portion 41 having the brush body 4 can be inclined at the predetermined angle α with respect to the central axis C_1 of the grip portion 40 held by the user for hand motion, so that it is possible to put the end of the brush to every corner of teeth, thereby improve operability during brushing and remove plaque efficiently..

[0025]

Moreover, as shown in FIG. 9, a main axis C_4 of the lever shaft 5 may be inclined with respect to a central axis C_3 of the driving shaft 3a in the first motion converting mechanism 51 so that the proximity of the brush 8 is inclined at an optional angle, and also, an axis C_5 which goes through the rotating shaft 10 the brush body 4 may be inclined from its direction with respect to the main axis C_4 of the lever shaft 5 in the second motion converting mechanism 52 to make the angle between the lever shaft 5 and the brush body 4 have an optional angle. In either case, the similar power transmission can be achieved through the first motion converting mechanism 51 and the second motion converting mechanism 52.

[0026]

Moreover, it is applicable that a pair of a first end portion and a second end portion 35b which have the configuration similar to the above lever shaft 5 are connected with each other so that a connection mechanism 53 which is formed by inserting a pin 17 into at the first end portion 35a transmits swing motion, the lever shaft 35a on the driving shaft 3a side is connected with the driving shaft 3a through the first motion converting mechanism 51 having the similar configuration, and the lever shaft 35b on the brush body 4 side is connected with the brush body 4 through the second motion converting mechanism 52 having the similar configuration. In this case, when the lever shaft 35b is inclined with respect to the lever

shaft 35a in the connection mechanism 53, the swing motion is transmitted without problems, so that the proximity of the brush 8 can have the optional angle by an optional setting of the inclined angle. It is also applicable that in addition to the lever shafts 35a and 36b, further lever shafts (not shown) similar to the lever shafts 35a and 36b are connected with each other in the axial direction and the plurality of the lever shafts 35a, 36b, ···are respectively inclined and connected with each other.

[0027]

Moreover, to achieve more effective brushing, as shown in FIG. 11, it is also applicable that the rotating shaft 10 of the brush body 4 is rotatably pivoted by a holding member 18 having a spherical side face 18a. and the holding member 18 is engaged with a cotyloid portion 19 formed at the inner side of the front end 2c of the housing 2 so as to freely rotate in the three-dimensional direction to form a spheroid joint. With such a configuration, the brush body 4 can freely change orientation in the three-dimensional direction, integrally with the holding member 18 holding the rotating shaft 10. Thus, the brush body 4 is inclined freely depending on the angle at which the brush 8 comes into contact with teeth during use and the tooth surface matches with the brush surface. As a result, smooth and efficient brushing can be achieved. Even when the brush body 4 is inclined in any direction, driving force is properly transmitted to the brush body 4 through the second motion converting mechanism 52.

[0028]

To improve safety of brushing, it is possible to make rotation angle of the brush body 4 smaller when the brush 8 is pressed strongly. Specifically, bending rigidity of the lever shaft 5 is set so that swinging range of the second end portion 5b located at the side of the brush body 4 of the lever shaft 5 becomes smaller as a load transmitted from the brush body 4 to the lever shaft 5 through the second motion converting mechanism 52 is increased. The bending rigidity of the lever shaft 5 can be set by properly selecting strength of the used material and geometrical moment of inertia. The relationship between rotation angle of the brush

body 4 and pressure of the brush 8 is shown in FIG. 12. In FIG. 12, a thin line A represents characteristics of a conventional electric toothbrush and a thick line B represents characteristics of the electric toothbrush in accordance with the third embodiment. In the conventional electric toothbrush, as represented by the thin line A, when pressure is increased, the number of revolutions is reduced, but rotation angle is kept substantially constant. Thus, there is the possibility that moving distance of the brush 8 stays unchanged, thereby causing damage to the gums and enamelum of the tooth surface. On the contrary, in the case where bending rigidity of the lever shaft 5 is set as described above, as represented by the thick line B, rotation angle is decreased as pressure is increased and moving distance of the brush 8 is decreased gradually. As a result, damage to the gums and enamelum of the tooth surface can be prevented, leading to a riskless electric toothbrush.

[0029]

It is also applicable to combine the above configurations based on FIG. 8 to FIG. 12 and use the combination, and in any combination, the driving force can properly be transmitted to the brush body 4 side through the first motion converting mechanism 51 and the second motion converting mechanism 52.

[0030]

FIG. 13 shows a head portion 41 which is detachable from a grip portion 40. In this case, the grip portion 40 has the motor 3 and the eccentric member 6 and the head portion 41 has the brush body 4 and the lever shaft 5. The eccentric member 6 and the joint portion 7 of the lever shaft 5 are not connected with each other when the head portion 41 is detached, but when attaching the head portion 41, the eccentric member 6 and the joint portion 7 are connected with each other to form the first motion converting mechanism 51, so that the configuration of the grip portion 40 side can made to be simple.

[0031]

Next, another example of an electric toothbrush according to the

preferred embodiment of the present invention is described. Since the following embodiment is different from the above embodiment only in configuration of the first motion converting mechanism 51, other components are designated by the same reference numerals and description thereof is omitted.

[0032]

As shown in FIG. 14, a driving shaft 3a is fitted to a link member 20. A first end portion 21a of a first link shaft 21 is connected with the position a predetermined distance L_1 from the driving shaft 3a of the link member 20 in the radial direction, and a second end portion 21b of the first link shaft 21 is protruded toward the side of a lever shaft 5. A first end portion 22a of a second link shaft 22 is connected with a first end portion 5a of the lever shaft 5 in parallel with the main axis of the lever shaft 5. A second end portion 22b of the second link shaft 22 is protruded toward the side of the driving shaft 3a. The second end portion 21b of the first link shaft 21 and the second end portion 22b of the second link shaft 22 are coupled with each other via a link arm 23 at a distance L_2 in the radial direction of the link member 20. At this time, the position of a fitting hole of a link arm 23 is set so that the distance between the first link shaft 21 and the second link shaft 22 is longer than the distance L1 between the driving shaft 3a of the motor 3 and the first link shaft 21 ($L_1 < L_2$). A lever shaft support plate 24 for restricting the direction of motion of the first end portion 5a to a predetermined linear direction is provided on the periphery of the first end portion 5a of the lever shaft 5.

[0033]

With such a configuration, as shown in FIG. 15, when the link member 20 rotates integrally with the driving shaft 3a of the motor 3, the first link shaft 21 performs rotating motion with a radius of L_1. In response to the rotating motion, the second link shaft 22 moves while keeping the distance L_2 from the first link shaft 21 via the link arm 23. However, since motion of the lever shaft 5 is restricted by the lever shaft support plate 24, the second link shaft 22 makes reciprocal linear motion in

the predetermined direction in response to rotating motion of the first link shaft 21. As a result, the first end portion 5a of the lever shaft 5 swings about the point 9.

[0034]

As described above, since the first link shaft 21 functions as a crank and the second link shaft 22 functions as a slider, a slider-crank mechanism 54 for converting rotating motion of the driving shaft 3a into reciprocal linear motion of the first end portion 5a of the lever shaft 5 is constituted.

[0035]

[Effect of the invention]

As described above, according to the invention described in claim 1, in the lever shaft , high accuracy in processing of parts is not required except for the point and decrease of transmission efficiency of force or noise can be efficiently avoided, and thus the simply and inexpensive electric toothbrush can be provided. Moreover, even when the lever shaft is not linearly formed, the force can be properly transmitted by supporting the lever shaft by the point, so that it becomes possible to incline the proximity of the brush body at an optional angle.

[0036]

Moreover, according to the invention described in claim 2, the power transmission can be realized with high efficiency by the simply structure in addition to the effect of the invention described in claim 1.

[0037]

Moreover, according to the invention described in claim 3, the occurrence of abrasion resistance is avoided and the life of the first motion converting mechanism can be extended in addition to the effect of the intention described in claim 2.

[0038]

Moreover, according to the invention described in claim 4, the power transmission can be realized with high efficiency by the simply structure in addition to the effect of the invention described in claim 1.

[0039]

Moreover, according to the invention described in claim 5, the power transmission can be realized with high efficiency by the simply structure in addition to the effect of the invention described in one of claims 1 to 4, and brush body which is put in a user's mouth is made smaller and thinner, so that operability during brushing can be improved. Furthermore, even when the brush body is inclined at an optional angle, the force can be properly transmitted, so that it becomes possible to incline the proximity of the brush body at an optional angle.

[0040]

Moreover, according to the invention described in claim 6, it is possible to put the end of the brush to every corner of teeth, thereby improve operability during brushing and remove plaque efficiently in addition to the effect of the invention described in one of claims 1 to 5.

[0041]

Moreover, according to the invention described in claim 7, it is possible to put the end of the brush to every corner of teeth, thereby improve operability during brushing and remove plaque efficiently in addition to the effect of the invention described in one of claims 1 to 6.

[0042]

Moreover, according to the invention described in claim 8, it is possible to incline the proximity of the brush body at an optional angle by connecting the adjacent lever shafts at an angle so that it is possible to put the end of the brush to every corner of teeth, thereby improve operability during brushing and remove plaque efficiently in addition to the effect of the invention described in one of claims 1 to 7.

[0043]

Moreover, according to the invention described in claim 9, the rotation angle of the brush body is decreased when the brush is highly pressed, and damage to the gums and enamelum of the tooth surface can be prevented while brushing in addition to the effect of the invention described in one of claims 1 to 8.

[0044]

Moreover, according to the invention described in claim 10, the brush body is rotated freely depending on the angle at which the brush comes into contact with teeth during use and the tooth surface matches with the brush surface, and smooth and efficient brushing can be achieved in addition to the effect of the invention described in one of claims 1 to 9.

[0045]

Moreover, according to the invention described in claim 11, the brush body becomes detachable and the configuration of the grip portion side can made to be simple in addition to the effect of the invention described in claims 1 to 10.

[Brief description of the drawings]

FIG. 1 shows one example of an electric toothbrush according to a preferred embodiment of the present invention, and FIG. 1(a) is a front sectional view and FIG. 1(b) is a side sectional view.

FIG. 2 is a perspective view showing an internal structure of the electric toothbrush in FIG. 1.

FIG. 3 is an exploded perspective view of the electric toothbrush in FIG. 1.

FIG. 4 is a schematic view of a first motion converting mechanism with a roller in the electric toothbrush in FIG. 1, and FIG. 4(a) shows a configuration before the roller is set up and FIG. 4(b) shows a configuration after the roller is set up.

FIG. 5 is a schematic view showing a second motion converting mechanism in the electric toothbrush in FIG. 1, and FIG. 5(a) shows a configuration of a lever shaft side and FIG. 5(b) is a configuration of a brush body side.

FIG. 6 is a schematic view of an attachment status in a second motion converting mechanism in the electric toothbrush in FIG. 1, and FIG. 6(a) shows a configuration before the attachment, FIG. 6(b) shows a configuration after the attachment, and FIG. 6(c) is a configuration when the driving force is transmitted.

FIG. 7 is a schematic view of an attachment status in a second

motion converting mechanism using another configuration in the electric toothbrush in FIG. 1, and FIG. 7(a) shows a configuration before the attachment, FIG. 7(b) shows a configuration after the attachment, and FIG. 7(c) is a configuration when the driving force is transmitted.

FIG. 8 is a schematic view of the electric toothbrush when the lever shaft is bended in the electric toothbrush in FIG. 1, and FIG. 8(a) shows the whole electric toothbrush, FIG. 8(b) shows an internal structure of the electric toothbrush, and FIG. 8(c) shows the lever shaft which has another bending location.

FIG. 9 is a schematic view of the electric toothbrush in FIG. 1 when the driving shaft and the lever shaft form an angle with each other

FIG. 10 is a schematic view of the electric toothbrush in FIG. 1 when a plurality of the lever shafts is coupled with each other in an axial direction.

FIG. 11 is a schematic view of the electric toothbrush in FIG. 1 when the brush body is rotatably supported in three dimensional direction.

FIG. 12 is a schematic view showing a comparison between the electric toothbrush in FIG. 1 and a conventional toothbrush when bending rigidity of the lever shaft is set in consideration of the safety.

FIG. 13 is a schematic view showing the electric toothbrush in FIG. 1 when a detachable brush body is provided.

FIG. 14 shows another example of an electric toothbrush according to a preferred embodiment of the present invention, and FIG. 14(a) is a front sectional view, FIG. 14(b) is an exploded view of FIG. 14(a), and FIG. 14(c) is a side sectional view of a proximity of a brush body.

FIG. 15 is a schematic view of a driving status in a first motion converting mechanism in the electric toothbrush in FIG. 14, and FIG. 15(a) shows an initial state, FIG. 15(b) shows a state when a first link shaft rotates 90 degrees, FIG. 15(c) shows a state when the first link shaft rotates 180 degrees, and FIG. 15(d) shows a state when the fist link shaft rotates 270 degrees.

[Description of the reference numerals]

1	electric toothbrush
3	motor
3a	driving shaft
4	brush body
5	lever shaft
5a	first end portion
5b	second end portion
6	eccentric member
7	joint portion
9	point
10	rotating shaft
11	roller
13	groove
14	pin
15	inflected portion
18	holding member
40	grip portion
41	head portion
51	first motion converting mechanism
52	second motion converting mechanism
54	slider-crank mechanism

[Document name] Abstract

[Abstract]

[Problem to be solved]

An electric toothbrush which has a simple configuration, high transmittance efficiency of driving force, and high operability is provided.

[Solution]

An electric toothbrush comprises a motor 3 having a driving shaft 3a, a lever shaft 5 which is provided substantially in range with the driving shaft 3a and is pivoted so as to swing about a predetermined point 9 to support rotationally end portions 5a and 5b, a brush body 4 pivoted so as to freely rotate about a rotating shaft which is located in an opposite side of the driving shaft 3a to be substantially perpendicular to the lever shaft 5, a first motion converting mechanism 51 which converts rotating motion of the driving shaft 3a into swinging motion of the first end portion 5a of the lever shaft 5, and a second motion converting mechanism 52 which converts swinging motion of the second end portion 5b of the lever shaft 5 into reciprocal rotating motion of the brush body 4.

[Selected drawing] FIG. 1